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Collecting Data

Collecting data is a critical part of the investigation. Although initial information is collected by the site readiness team, the detailed information collected by the accident investigation board is the foundation for the entire investigation, including the analyses and conclusions. These in turn become the basis for identifying preventive measures to preclude recurrences. Consequently, it is important to ensure that all relevant information is collected and that the information is accurate.

Gathering and analyzing information is an interdependent process that takes place throughout the first three weeks of the investigation cycle. As preliminary analysis is conducted on the initial evidence, gaps will become apparent, requiring the board to collect additional evidence. Generally, many data collection and analysis iterations occur before the board can be certain that all pertinent evidence has been gathered and analyses are finalized.

Upon arrival of the accident investigation board, the point of contact briefs the board members on all actions taken by the site readiness team and other emergency response personnel. It is important that the board become familiar with the initial investigative actions conducted prior to their arrival. At this time, all evidence the site readiness team has collected, including lists of witnesses, witness statements, and other important documents, are also turned over to the board.

Three key types of evidence are collected during the investigation:

- ***Human or testamentary evidence*** includes witness statements and observations
- ***Physical evidence*** is matter related to the accident (e.g., equipment, parts, debris, hardware, and other physical items)
- ***Documentary evidence*** includes paper and electronic information, such as records, reports, procedures, and documentation.

The investigation board expands and builds on results from the site readiness team's initial activities. Therefore, the board chairperson must obtain a timely assessment of what has been done and determine the board's immediate actions. It may be helpful for the board chairperson to designate one board member to oversee evidence collection.

Collecting evidence can be a lengthy, time-consuming, and piecemeal process. Witnesses may provide sketchy or conflicting accounts of the accident. Physical evidence may be badly damaged or completely destroyed. Documentary evidence may be minimal or difficult to access. Thorough investigation requires that board members be diligent in pursuing evidence and adequately explore leads, lines of inquiry, and potential causal factors until they gain a sufficiently complete understanding of the accident.

The process of collecting data is iterative. Preliminary analysis of the initial evidence identifies gaps that will direct subsequent data collection. Generally, many data collection and analysis iterations occur before the board can be certain that all analyses can be finalized. The process of data collection also requires a tightly coordinated, interdependent set of activities on the part of several investigators.

TIP
It may be helpful for the board chairperson to designate one board member to oversee evidence collection.

The process of pursuing evidentiary material involves:

- Collecting human evidence (locating and interviewing witnesses)
- Collecting physical evidence (identifying, documenting, inspecting, and preserving relevant matter)
- Collecting documentary evidence
- Examining organizational concerns, management systems, and line management oversight
- Preserving and controlling evidence.

6.1 Collecting Human Evidence

Human evidence is often the most insightful and also the most fragile. Witness recollection declines rapidly in the first 24 hours following an accident or traumatic event. Therefore, witnesses should be located and interviewed immediately and with high priority. As physical and documentary evidence is gathered and analyzed throughout the investigation, this new information will often prompt follow-up interviews with persons previously not interviewed, and additional lines of questioning.

6.1.1 Locating Witnesses

Principal witnesses and eyewitnesses are identified and interviewed as soon as possible. Principal witnesses are persons who were actually involved in the accident; eyewitnesses are persons who directly observed the accident or the conditions immediately preceding or following the accident. General witnesses are those with knowledge about the activities prior to or immediately after the accident (the previous shift supervisor or work controller, for example). One responsibility of the site readiness team and other initial responders is to identify witnesses, record initial statements, and provide this information to the investigation board upon their arrival. Prompt arrival by board members and expeditious interviewing of witnesses helps ensure that witness statements are as accurate, detailed, and authentic as possible.

Table 6-1 lists sources that investigators can use to locate witnesses.

6.1.2 Conducting Interviews

Witness testimony is an important element in determining facts that reveal causal factors. It is best to interview principal witnesses and eyewitnesses first, because they often provide the most useful details regarding what happened. If not questioned promptly, they may forget important details.

TIP
The investigator should first get an overview of the accident and then expand information with careful questioning.

6.1.2.1 Preparing for Interviews

Much of the investigation's fact-finding occurs in interviews. Therefore, to elicit the most useful information possible from interviewees, interviewers must be well prepared and have clear objectives for each interview. Interviews can be conducted after the board has established the topical areas to be covered in the interviews and after the board chairperson has reviewed with the board the objectives of the interviews and strategies for obtaining useful information. Table 6-2 provides guidelines for interview preparation.

Table 6-1. These sources are useful for locating witnesses.

Site readiness team members and emergency response personnel can name the person who provided notification of the incident and those present on their arrival, as well as the most complete list available of witnesses and all involved parties.
Principal witnesses and eyewitnesses are the most intimately involved in the accident and may be able to help develop a list of others directly or indirectly involved in the accident.
First-line supervisors are often the first to arrive at an accident scene and may be able to recall precisely who was present at that time or immediately before the accident. Supervisors can also provide the names and phone numbers of safety representatives, facility designers, and others who may have pertinent information.
Local or state police, firefighters, or paramedics, if applicable.
Nurses or doctors at the site first aid center or medical care facility (if applicable).
Staff in nearby facilities (those who may have initially responded to the accident scene; staff at local medical facilities).
News media may have access to witness information and photographs or videos of the post-accident scene.
Maintenance and security personnel may have passed through the facility soon before or just after the accident.

Table 6-2. It is important to prepare for interviews.

Identify all interviewees using the *Accident Investigation Preliminary Interview List* (provided in Section 4). Record each witness' name, job title, reason for interview, phone, work schedule, and company affiliation; take a brief statement of his or her involvement in the accident.
Schedule an interview with each witness using the *Accident Investigation Interview Schedule Form* (provided at the end of this section). Designate one person to oversee this process. Previous boards have found it useful to make the administrative coordinator responsible for scheduling initial and follow-up interviews and written statement verifications.
Assign a lead interviewer from the board for each interviewee. Having a lead interviewer can help establish consistency in depth and focus of interviews.
Develop sketches and diagrams to pinpoint locations of witnesses, equipment, etc., based on the initial walk-through and site readiness team input.
Develop a standardized set of interview questions. Charts may be used to assist in developing questions. The *Accident Investigation Interview Form* (provided at the end of this section) can aid in recording pertinent data.
Discuss interviewing objectives and plan strategies to ensure that all board members use consistent interviewing methods. To enhance the quality of information obtained, everyone should have some training on correct interviewing techniques.
Determine the appropriate means of documenting interviews (handwritten notes, court reporter, etc.) in light of the circumstances. Experience indicates that a court reporter generally is preferable.

People's memories, as well as their willingness to assist an investigative board, can be affected by the way they are questioned. Based on the availability of witnesses, board members' time, and the nature and complexity of the accident, the board chairperson and members must determine who to interview, in what order, and what interviewing techniques to employ. Some methods that previous accident investigation boards have found successful are described below.

TIP
A witness interview is not an interrogation. Investigators should convey the sense of a cooperative, informal meeting.

Individual vs. Group Interviews. Depending on the specific circumstances and schedule of an accident investigation, investigators may choose to hold either individual or group interviews. Generally, principal witnesses and eyewitnesses are interviewed individually to gain independent accounts of the event. However, a group interview may be beneficial in situations where a work crew was either involved in or witness to the accident. Moreover, time may not permit interviewing every witness individually, and the potential for gaining new information from every witness may be small. Sometimes, group interviews can corroborate testimony given by an individual, but not provide additional details. The board should use their collective judgment to determine which technique is appropriate. Advantages and disadvantages of both techniques are listed in Table 6-3. These considerations should be weighed against the circumstances of the accident when determining which technique to use.

Interviewing: Do's and Don'ts. Table 6-4 lists actions that promote effective interviews, and Table 6-5 lists actions to avoid while conducting interviews.

It is important to create a comfortable atmosphere in which interviewees are not rushed to recall their observations. Interviewees should be told that they are a part of the investigation effort and that their input will be used to prevent future accidents and not to assign blame. Before and after questioning, interviewees should be notified that follow-up interviews are a normal part of the investigation process and that further interviews do not mean that their initial statements are suspect. Also, they should be encouraged to contact the board whenever they can provide additional information or have any concerns.

Table 6-3. Group and individual interviews have different advantages.

	Individual Interviews	Group Interviews
Advantages	■ Obtain independent stories ■ Obtain individual perceptions ■ Establish one-to-one rapport	■ More time-efficient ■ All interviewees supplement story; may get more complete picture ■ Other people serve as "memory joggers"
Disadvantages	■ More time-consuming ■ May be more difficult to schedule all witnesses	■ Interviewees will not have independent stories ■ More vocal members of the group will say more and thus may influnce those who are quieter ■ "Group think" may develop; some individual details may get lost ■ Contradictions in accounts may not be revealed

Table 6-4. Interviewing do's.

Create a Relaxed Atmosphere	
√	Conduct the interview in a neutral location that was not associated with the accident.
√	Introduce yourself and shake hands.
√	Be polite, patient, and friendly.
√	Treat witnesses with respect.
Prepare the Witness	
√	Describe the investigation's purpose: to prevent accidents, not to assign blame.
√	Explain that witnesses may be interviewed more than once.
√	Use the Model Opening Statement to address FOIA and Privacy Act concerns.
√	Stress how important the facts given during interviews are to the overall investigative process.
Record Information	
√	Rely on a court reporter to provide a detailed record of the interview.
√	Note crucial information immediately in order to ask meaningful follow-up questions.
Ask Questions	
√	Establish a line of questioning and stay on track during the interview.
√	Ask the witness to describe the accident in full before asking a structured set of questions.
√	Let witnesses tell things in their own way; start the interview with a statement such as "Would you please tell me about...?"
√	Ask several witnesses similar questions to corroborate facts.
√	Aid the interviewee with reference points; e.g., "How did the lighting compare to the lighting in this room?"
√	Keep an open mind; ask questions that explore what has already been stated by others in addition to probing for missing information.
√	Use visual aids, such as photos, drawings, maps, and graphs to assist witnesses.
√	Be an active listener, and give the witness feedback; restate and rephrase key points.
√	Ask open-ended questions that generally require more than a "yes" or "no" answer.
√	Observe and note how replies are conveyed (voice inflections, gestures, expressions, etc.).
Close the Interview	
√	End on a positive note; thank the witness for his/her time and effort.
√	Allow the witness to read the interview transcript and comment if necessary.
√	Encourage the witness to contact the board with additional information or concerns.
√	Remind the witness that a follow-up interview may be conducted.

Table 6-5. Interviewing don’ts.

√	DO NOT rush the witness while he/she is describing the accident or answering questions.
√	DO NOT judge, display anger, refute, threaten, intimidate, or blame the witness.
√	DO NOT suggest answers.
√	DO NOT make promises that cannot be kept (for example, unrestricted confidentiality).
√	DO NOT use inflammatory words ("violate," "kill," “lie," "stupid," etc.).
√	DO NOT omit questions during the interview because you think you already know the answer.
√	DO NOT ask questions that suggest an answer, such as "Was the odor like rotten eggs?"

Before each interview, interviewees should be apprised of Freedom of Information Act (FOIA) and Privacy Act concerns as they pertain to their statements and identity. A model opening statement that addresses FOIA and Privacy Act provisions can be found at the end of this section. Interviewees should be aware that information provided during the investigation may not be precluded from release under FOIA or the Privacy Act. For further information consult Section IV, Paragraph 2.2.5.7 of the Implementation Guide for Use with DOE Order 225.1A (DOE G225.1-1). If any questions arise concerning the disclosure of accident investigation records or the applicability of the FOIA or the Privacy Act, guidance should be obtained from the FOIA/Privacy Act attorney at either Headquarters or the field. Most sites have FOIA/Privacy Act specialists who can be consulted for further guidance.

Following these guidelines will help ensure that witness statements are provided freely and accurately, subsequently improving the quality and validity of the information obtained.

6.1.2.2 Evaluating the Witness's State of Mind

Occasionally, a witness's state of mind may affect the accuracy or validity of testimony provided. In conducting witness interviews, investigators should consider:

- The amount of time between the accident and the interview. People normally forget 50 to 80 percent of the details in just 24 hours.
- Contact between this witness and others who may have influenced how this witness recalls the events.
- Signs of stress, shock, amnesia, or other trauma resulting from the accident. Details of unpleasant experiences are frequently blanked from one’s memory.

Investigators should note whether an interviewee displays any apparent mental or physical distress or unusual behavior; it may have a bearing on the interview results. These observations can be discussed and their impact assessed with other members of the board.

6.2 Collecting Physical Evidence

TIP
To ensure consistent documentation, control, and security, it may be useful to designate a single board member or the administrative coordinator to be in charge of handling evidence.

Following the leads and preliminary evidence provided by the initial findings of the site readiness team, the board proceeds

in gathering, cataloging, and storing physical evidence from all sources as soon as it becomes available. The most obvious physical evidence related to an accident or accident scene often includes solids such as:

- Equipment
- Tools
- Materials
- Hardware
- Plant facilities
- Pre- and post-accident positions of accident-related elements
- Scattered debris
- Patterns, parts, and properties of physical items associated with the accident.

Less obvious but potentially important physical evidence includes fluids (liquids and gases). Many DOE facilities use a multitude of fluids, including chemicals, fuels, hydraulic control or actuating fluids, and lubricants. Analyzing such evidence can reveal much about the operability of equipment and other potentially relevant conditions or causal factors.

Care should be taken if there is the potential for pathogenic contamination of physical evidence (e.g., blood); such material may require autoclaving or other sterilization. Specialized technicians experienced in fluid sampling should be employed to help the board collect and analyze fluid evidence. If required, expert analysts can be requested to perform tests on the fluids and report results to the board.

When handling potential bloodborne pathogens, universal precautions such as those listed in Table 6-6 should be observed to minimize potential exposure. All human blood and body fluids should be treated as if they are infectious. The precautions in Table 6-6 should be implemented for all potential exposures. Exposure is defined as reasonable anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials.

TIP
Significant physical evidence is often found in obscure and seemingly insignificant places, such as hinges and supports.

Physical evidence should be systematically collected, protected, preserved, evaluated, and recorded to ultimately determine how and why failures occurred and whether use, abuse, misuse, or nonuse was a causal factor.

6.2.1 Documenting Physical Evidence

Evidence should be carefully documented at the time it is obtained or identified. The Accident Investigation Physical Evidence Log Form (provided at the end of this section) can help investigators document and track the collection of physical evidence. Additional means of documenting physical evidence include sketches, maps, photographs, and videotape.

6.2.1.1 Sketching and Mapping Physical Evidence

Sketching and mapping the position of debris, equipment, tools, and injured persons may be initiated by the site readiness team and expanded on by the accident investigation board. Position maps convey a visual representation of the scene immediately after an accident. Evidence may be inadvertently moved, removed, or destroyed, especially if the accident scene can only be partially secured. Therefore, sketching and mapping should be conducted immediately after recording initial witness statements.

Precise scale plottings of the position of elements can subsequently be examined to develop and test accident causal theories.

Table 6-6. Use these universal precautions when handling potential bloodborne pathogens.

Personal protective equipment should be worn when exposure to bloodborne pathogens is likely.
Hands and other skin should be washed with soap and water immediately or as soon as feasible after removal of gloves or other personal protective equipment.
Handwashing facilities should be provided that are readily accessible to employees.
When provision of handwashing facilities is not feasible, appropriate antiseptic hand cleanser in conjunction with clean cloth, paper towels, or antiseptic towelettes should be used. Hands should be washed with soap and water as soon as possible thereafter.
Mucous membranes should be flushed with water immediately or as soon as feasible following contact with blood or other potentially infectious materials.
Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed except by approved techniques.
Immediately or as soon as possible after use, contaminated reusable sharps shall be placed in appropriate containers until properly reprocessed.
Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure.
Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets, or on countertops or benchtops where blood or other potentially infectious materials are present.
All procedures involving blood or other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.
Mouth pipetting or suctioning of blood or other potentially infectious materials is prohibited.
Specimens of blood or other potentially infectious materials shall be placed in a container to prevent leakage during collection, handling, processing, storage, transport, or shipping.
Equipment, which may become contaminated with blood or other potentially infectious materials, shall be examined prior to servicing or shipping and shall be decontaminated as necessary.

The *Accident Investigation Site Sketch, Accident Investigation Site Map, Accident Investigation Position Mapping Form,* and *Accident Investigation Sketch of Physical Evidence Locations and Orientations* (provided at the end of this section) are useful for drawing sketches and maps and recording positions of objects.

6.2.1.2 Photographing and Videotaping Physical Evidence

TIP

Photography and videography can be used in a variety of ways to emphasize areas or items of interest and display them for better understanding. These are best performed by specialists, but should be supervised and directed by an investigator.

Photography is a valuable and versatile tool in accident investigation. Photos or videos can identify, record, or preserve physical accident evidence that cannot be effectively conveyed by words or collected by any other means.

Photographic coverage should be detailed and complete, including standard references to help establish distance and perspective. Videotapes should cover the overall accident scene, as well as specific locations or items of significance. A thorough videotape allows the board to minimize trips to the accident scene. This may be important if the scene is difficult to access or if it presents hazards. The *Accident Investigation Photographic Log Sheet* (provided at the end of this section) can be used to record photograph or videotape subjects, dates, times, and equipment settings and positions.

Good photographic coverage of the accident is essential, even if photographs or video stills will not be used in the investigation

report. However, if not taken properly, photographs and videos can easily misrepresent a scene and lead to false conclusions or findings about an accident. Therefore, whenever possible, accident photography and videotaping should be performed by professionals. Photographic techniques that avoid misrepresentation, such as the inclusion of rulers and particular lighting, may be unknown to amateurs but are common knowledge among professional photographers and videographers.

One of the first responsibilities of the board chairperson should be to acquire a technical photographer whose work will assist the board. Five possible sources include:

- In-plant photo lab
- Other DOE or DOE contractor photo labs
- Commercial photographers; industrial, medical, aerial, legal, portrait, and scientific photographers (perhaps the best to assist in accident investigation are industrial, legal, or scientific photographers)
- A member of the investigation board
- Security personnel.

Even if photos are taken by a skilled photographer, the investigation board should be prepared to direct the photographer in capturing certain important perspectives or parts of the accident scene. Photographs of evidence and of the scene itself should be taken from many angles to illustrate the perspectives of witnesses and injured persons. In addition, board members may wish to take photos for their own reference. If available, digital photography will facilitate incorporation of the photographs into the investigation report. However, if this is not practical, high-quality 35mm photographs can be scanned for incorporation in the report.
As photos are taken, a log should be completed noting the scene/subject, date, time, direction, and orientation of photos, as well as the photographer's name. The Accident Investigation Photographic Log Sheet can be used for this purpose.
The Accident Investigation Sketch of Photography Locations and Orientations (provided at the end of this section) is helpful when reviewing photos and analyzing information.

6.2.2 Inspecting Physical Evidence

Following initial mapping and photographic recording, a systematic inspection of physical evidence can begin. The inspection involves:

- Surveying the involved equipment, vehicles, structures, etc., to ascertain whether there is any indication that component parts were missing or out of place before the accident

- Noting the absence of any parts of guards, controls, or operating indicators (instruments, position indicators, etc.) among the damaged or remaining parts at the scene

- Identifying as soon as possible any equipment or parts that must be cleaned prior to examination or testing and transferring them to a laboratory or to the care of an expert experienced in appropriate testing methodologies

- Noting the routing or movements of records that can later be traced to find missing components

- Preparing a checklist of complex equipment components to help ensure a thorough survey.

These observations should be recorded in notes and photographs so that investigators avoid relying on their memories. Some investigators find a small cassette tape recorder useful in recording general descriptions of appearance and damage; however, the potential failure of a recorder, inadvertent tape erasure, and limitations of verbal description suggest that verbal

recorded descriptions should be used in combination with notes, sketches, and photographs.

6.2.3 Removing Physical Evidence

Following the initial inspection of the scene, investigators may need to remove items of physical evidence. To ensure the integrity of evidence for later examination, the extraction of parts must be controlled and methodical. The process may involve simply picking up components or pieces of damaged equipment, removing bolts and fittings, cutting through major structures, or even recovering evidence from beneath piles of debris. Before evidence is removed from the accident scene, it should be carefully packaged and clearly identified. The readiness team or a pre-assembled investigator's kit can provide general-purpose cardboard tags or adhesive labels for this purpose.

Equipment or parts thought to be defective, damaged, or improperly assembled should be removed from the accident scene for technical examination. The removal should be documented using position maps and photos to display the part in its final, post-accident position and condition. If improper assembly is suspected, investigators should direct that the part or equipment be photographed and otherwise documented as each subassembly is removed.

Items that have been fractured or otherwise damaged should be packaged carefully to preserve surface detail. Delicate parts should be padded and boxed. Both the part and the outside of the package should be labeled. Greasy or dirty parts can be wrapped in foil and placed in polyethylene bags or other nonabsorbent materials for transport to a testing laboratory, command center, or evidence storage facility. If uncertainties arise, subject matter experts can advise the board regarding effective methods for preserving and packaging evidence and specimens that must be transported for testing.

When preparing to remove physical evidence, these guidelines should be followed:

- Normally, extraction should not start until witnesses have been interviewed, since visual reference to the accident site can stimulate one's memory
- Extraction and removal or movement of parts should not be started until position records (measurements for maps, photographs and videotape) have been made
- Be aware that the accident site may be unsafe due to dangerous materials or weakened structures
- Locations of removed parts can be marked with orange spray paint or wire-staffed marking flags; the marking flags can be annotated to identify the part removed and to allow later measurement
- Care during extraction and preliminary examination is necessary to avoid defacing or distorting impact marks and fracture surfaces
- The board chairperson and investigators should concur when the parts extraction work can begin, in order to assure that board members have completed all observations requiring an intact accident site.

6.3 Collecting Documentary Evidence

Documentary evidence can provide important data and should be preserved and secured as methodically as physical evidence. This information might be in the form of paper, photos, videotape, magnetic

tape, or electronic media, either at the site or in files at other locations.

Some work/process/system records are retained only for the workday or the week. Once an accident has occurred, the board must work quickly to collect and preserve these records so they can be examined and considered in the analysis.

Accident investigation preplanning should include procedures for identifying records to be collected, as well as the people responsible for their collection. Because records are usually not located at the scene of the accident, they are often overlooked in the preliminary collection of evidence.

Documents often provide important evidence for identifying causal factors of an accident. This evidence is useful for:

- Thoroughly examining the policies, standards, and specifications that molded the environment in which the accident occurred
- Indicating the attitudes and actions of people involved in the accident
- Revealing evidence that generally is not established in verbal testimony.

Documentary evidence generally can be grouped into four categories:

- Management control documents that communicate management expectations of how, when, where, and by whom work activities are to be performed
- Records that indicate past and present performance and status of the work activities, as well as the people, equipment, and materials involved
- Reports that identify the content and results of special studies, analyses, audits, appraisals, inspections, inquiries, and investigations related to work activities
- Follow-on documentation that describes actions taken in response to the other types of documentation.

Collectively, this evidence gives important clues to possible underlying causes of errors, malfunctions, and failures that led to the accident.

6.4 Examining Organizational Concerns, Management Systems, and Line Management Oversight

DOE Order 225.1A requires that the investigation board "examine policies, standards, and requirements that are applicable to the accident being investigated, as well as management and safety systems at Headquarters and in the field that could have contributed to or prevented the accident." Additionally, DOE Order 225.1A, Paragraph 4.c.(2)(b) and (d), requires the board to "evaluate the effectiveness of management systems, as defined by DOE Policy 450.4 (Safety Management System Policy), the adequacy of policy and policy implementation, and the effectiveness of line management oversight as they relate to the accident." Therefore, accident investigations must thoroughly examine organizational concerns, management systems, and line management oversight processes to determine whether deficiencies in these areas contributed to causes of the accident. The investigation board should consider the full range of management systems from the first-line supervisor level, up to and including site and Headquarters, as appropriate. It is important to note that this focus should not be directed toward individuals.

In determining sources and causes of management system inadequacies and the failure to anticipate and prevent the conditions leading to the accident,

investigators should use the framework of DOE's integrated safety management system established by the Department in DOE Policy 450.4. This policy lists the objective, guiding principles, core functions, mechanisms, responsibilities, and implementation means of an effective safety management system.

The safety management system elements described in DOE Policy 450.4 should be considered when deciding who to interview, what questions to ask, what documents to collect, and what facts to consider pertinent to the investigation. Even more importantly, these elements should be considered when analyzing the facts to determine their significance to the causal factors of the accident.

In many accidents, deficiencies in implementing the five core safety management functions defined in DOE Policy 450.4 cause or contribute to the accident. The five core functions are: (1) define the scope of work; (2) identify and analyze the hazards associated with the work; (3) develop and implement hazard controls; (4) perform work safely within the controls; and (5) provide feedback on adequacy of the controls and continuous improvement in defining and planning the work. Table 6-7 contains a list of typical questions board members may ask to determine whether any deficiencies in the implementation of the core functions affected the accident sequence.

Table 6-8 contains a list of typical questions board members may ask to determine whether line management deficiencies affected the accident. These questions are based on the seven guiding principles of DOE Policy 450.4.

The questions in Tables 6-7 and 6-8 are provided in Appendix D to facilitate use by the board. These are not intended to be exhaustive. Board members should adapt these questions or develop new ones based on the specific characteristics of the accident. The answers to the questions may be used to determine the facts of the accident, which, along with the analytical tools described in Section 7, will enable the board to determine whether deficiencies found in management systems and line management oversight are causal factors for the accident.

6.5 Preserving and Controlling Evidence

Preserving and controlling evidence are essential to the integrity and credibility of the investigation. Security and custody of evidence are necessary to prevent its alteration or loss and to establish the accuracy and validity of all evidence collected.

The point of contact is responsible for assuring that a chain of custody is established for all evidence removed from the accident scene before the board arrives.

The board chairperson is responsible for establishing an evidentiary custody protocol to ensure that all evidence is well documented at the accident scene and carefully controlled when it is removed and stored after the board arrives. Evidence control procedures similar to the following guidelines will help assure that evidence is not adulterated, corrupted, or lost and that subsequent engineering tests, if conducted, and other analytical results are valid.

- Evidence should be photographed and/or videotaped in its original location immediately following the accident, provided it does not interfere with rescue or amelioration activities

- A log should be maintained stating the location, date, and time that photos and videos are taken. The *Accident Investigation Photographic Log Sheet*

Table 6-7. These are typical questions for addressing the five core functions of integrated safety management.

Function #1: Define the scope of work.
■ Were the purpose and scope of the work to be performed clearly defined so that workers could identify any unanticipated conditions and actions that would be outside the authorized work scope? ■ Were expectations regarding the removal or control of hazards clearly defined and communicated to the workers? ■ Were the required safety support activities identified? ■ Were roles, responsibilities, and authorities for the work activity defined and executed appropriately? ■ Were the worker qualifications required to safely perform the work identified? ■ Were the design, operation, and configuration of equipment known and considered in work planning? ■ Were the characteristics of the work environment known and considered in work planning?
Function #2: Identify and analyze the hazards.
■ Were the type and magnitude of all possible hazards clearly understood by line management, supervisors, and workers? ■ Were the hazards analyzed and potential consequences documented? ■ Did the workers provide input to the hazard analysis? ■ Did the workers receive any feedback regarding their input? ■ Were the standards and requirements associated with the hazards identified?
Function #3: Develop and implement hazard controls.
■ Were required physical and engineering hazard controls evaluated for likely effectiveness under the expected work conditions? ■ Were the required administrative controls, such as technical procedures and safety support personnel, in place? ■ Were the workers qualified and given hazard- or activity-specific training? ■ Was a proper review, approval, and configuration control process in place?
Function #4: Perform work within controls.
■ Was the readiness to perform the work checked and confirmed prior to starting work? ■ Was appropriate authorization received to start work? ■ Was the work performed as planned (i.e., by the intended workers using the pre-approved procedures with the required level of supervision and safety support present with effective hazard controls in place)? ■ Were the workers empowered to stop work if unanticipated or unsafe conditions arose?
Function #5: Provide feedback and continuous improvement.
■ Was there a system to collect and use feedback from workers on workplace hazards? ■ Were workers aware of any hazards affecting the work activity that were not addressed in planning for it? ■ Was management aware of the hazard(s) identified by the workers? ■ Were there any lessons learned locally, from audit or evaluation results or from external operating experience, that applied to the work activity but were not addressed in planning for it?

Table 6-8. These are typical questions for addressing the seven guiding principles of integrated safety management.

Guiding Principle #1: Line management is directly responsible for the protection of the public, workers, and the environment.

- Did DOE assure and contractor line management establish documented safety policies and goals?
- Was integrated safety management policy fully implemented down to the activity level at the time of the accident?
- Was DOE line management proactive in assuring timely implementation of integrated safety management by line organizations, contractors, subcontractors, and workers?
- Were environment, safety and health (ES&H) performance expectations for DOE and contractor organizations clearly communicated and understood?
- Did line managers elicit and empower active participation by workers in safety management?

Guiding Principle #2: Clear lines of authority and responsibility for ensuring safety shall be established and maintained at all organizational levels within the Department and its contractors.

- Did line management define and maintain clearly delineated roles and responsibilities for ES&H to effectively integrate safety into sitewide operations?
- Was a process established to ensure that safety responsibilities were assigned to each person (employees, subcontractors, temporary employees, visiting researchers, vendor representatives, lessees, etc.) performing work?
- Did line management establish communication systems to inform the organization, other facilities, and the public of potential ES&H impacts of specific work processes?
- Were managers and workers at all levels aware of their specific responsibilities and accountability for ensuring safe facility operations and work practices?
- Were individuals held accountable for safety performance through performance objectives, appraisal systems, and visible and meaningful consequences?
- Did DOE line management and oversight hold contractors and subcontractors accountable for ES&H through appropriate contractual and appraisal mechanisms?

Guiding Principle #3: Personnel shall possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.

- Did line managers demonstrate a high degree of technical competence and understanding of programs and facilities?
- Did line management have a documented process for assuring that DOE personnel, contractors, and subcontractors were adequately trained and qualified on job tasks, hazards, risks, and Departmental and contractor policies and requirements?
- Were mechanisms in place to assure that only qualified and competent personnel were assigned to specific work activities, commensurate with the associated hazards?
- Were mechanisms in place to assure understanding, awareness, and competence in response to significant changes in procedures, hazards, system design, facility mission, or life cycle status?
- Did line management establish and implement processes to ensure that ES&H training programs effectively measure and improve performance and identify training needs?
- Was a process established to ensure that (1) training program elements were kept current and relevant to program needs, and (2) job proficiency was maintained?

Table 6-8. These are typical questions for addressing the seven guiding principles of integrated safety management.

Guiding Principle #4: Resources shall be effectively allocated to address safety, programmatic, and operational considerations. Protecting the public, the workers and the environment shall be a priority whenever activities are planned and performed.
■ Did line management demonstrate a commitment to ensuring that ES&H programs had sufficient resources and priority within the line organization? ■ Did line management clearly establish that integrated safety management was to be applied to all types of work and address all types of hazards? ■ Did line management institute a safety management system that provided for integration of ES&H management processes, procedures, and/or programs into site, facility, and work activities in accordance with the Department of Energy Acquisition Regulation (DEAR) ES&H clause (48 CFR 970.5204-2)? ■ Were prioritization processes effective in balancing and reasonably limiting the negative impact of resource reductions and unanticipated events on ES&H funding?
Guiding Principle #5: Before work is performed, the associated hazards shall be evaluated and an agreed-upon set of safety standards shall be established that, if properly implemented, will provide adequate assurance that the public, the workers, and the environment are protected from adverse consequences.
■ Was there a process for managing requirements, including the translation of standards and requirements into policies, programs, and procedures, and the development of processes to tailor requirements to specific work activities? ■ Were requirements established commensurate with the hazards, vulnerabilities, and risks encountered in the current life cycle stage of the site and/or facility? ■ Were policies and procedures, consistent with current DOE policy, formally established and approved by appropriate authorities? ■ Did communication systems assure that managers and staff were cognizant of all standards and requirements applicable to their positions, work, and associated hazards?
Guiding Principle #6: Administrative and engineering controls to prevent and mitigate hazards shall be tailored to the work performed and associated hazards.
■ Were the hazards associated with the work activity identified, analyzed, and categorized so that appropriate administrative and engineering controls could be put in place to prevent or mitigate the hazards? ■ Were hazard controls established for all stages of work to be performed (e.g., normal operations, surveillance, maintenance, facility modifications, decontamination, and decommissioning)? ■ Were hazard controls established that were adequately protective and tailored to the type and magnitude of the work and hazards and related factors that impact the work environment? ■ Were processes established for ensuring that DOE contractors and subcontractors test, implement, manage, maintain, and revise controls as circumstances change? ■ Were personnel qualified and knowledgeable of their responsibilities as they relate to work controls and work performance for each activity?

Table 6-8. These are typical questions for addressing the seven guiding principles of integrated safety management. (Continued)

Guiding Principle #7: The conditions and requirements to be satisfied for operations to be initiated and conducted shall be clearly established and agreed upon.

- Were processes in place to assure the availability of safety systems and equipment necessary to respond to hazards, vulnerabilities, and risks present in the work environment?
- Did DOE and contractor line management establish and agree upon conditions and requirements that must be satisfied for operations to be initiated?
- Was a management process established to confirm that the scope and authorization documentation is adequately defined and directly corresponds to the scope and complexity of the operations being authorized?
- Was a change control process established to assess, approve, and reauthorize any changes to the scope of operations ongoing at the time of the accident?

can be used for this purpose. Avoid using photographic attachments that digitally record the date and time on the negative because these images become a permanent part of the photo and may obscure evidence or important details in the photo or video. The computerized/ printed date on the back of photos provided by film processors should be used in conjunction with, not in lieu of, a photo log, because the date on photos gives the day the film was processed, not the day the photos were taken.

- Board members should prepare and sign an inventory of all evidentiary items collected, including statements regarding:
  - Items removed from the scene
  - Date and time items were removed
  - Person who removed items
  - Location where those items will be stored.

- Evidence should be controlled by signature transfer (signatures of the recipient and the person relinquishing custody) and made available only to those who need to examine and use the evidence during the accident investigation. The *Accident Investigation Physical Evidence Log Form* may be used for this purpose.

- Secure storage should be obtained immediately, and access to evidence controlled throughout the investigation.

- Access to the room or suite of offices used by the investigation board should be restricted. No one other than board members, advisors, and support staff should have access to the board's office space; this includes janitorial staff.

- The board chairperson should determine the disposition of evidence at the conclusion of the investigation.

Documentary evidence can easily be overlooked, misplaced, or taken. Documents can be altered, disfigured, misinterpreted, or electronically corrupted. Computer software and disks can be erased by exposure to magnetic fields. As with other evidence collected during the investigation, documentary evidence should be collected, inventoried, controlled, and secured (in locked containers, if necessary).

TIP

Protect all records relating to the accident until investigation activities or analysis of those records determines that they are not relevant to the accident.

KEY POINTS TO REMEMBER

- Gather as much evidence as quickly as possible. It is easier to discount an item later than to capture or reconstruct it later.

- Assess initial response activities performed by the site readiness team to determine any gaps or immediate concerns. Formulate initial plans for evidence collection based on this assessment.

- Three types of evidence are gathered during accident investigations:
  - **Human or testamentary evidence** (witness statements and observations)
  - **Physical evidence** (matter related to the accident such as equipment, parts, fluids, debris, hardware, and other physical items)
  - **Documentary evidence** (paper and electronic information).

- Develop and implement effective procedures to preserve and control evidence because they are necessary to ensure the accuracy and validity of the evidence and essential to the integrity and credibility of the investigation.

- The five major steps in gathering evidence are:
  - Collecting human evidence (locating and interviewing witnesses)
  - Collecting physical evidence
  - Collecting documentary evidence
  - Examining organizational concerns, management systems, and line management oversight
  - Preserving and controlling evidence.

- Identify witnesses as quickly as possible to obtain witness statements. Sources for locating witnesses include site readiness and emergency response personnel, principal witnesses, eyewitnesses, first line supervisors, police, firefighters, paramedics, nurses or doctors, news media, and maintenance and security personnel.

- Promoting effective interviews includes careful preparation, creating a relaxed atmosphere, preparing the witness for the interview, recording the interview (preferably by using a court reporter to document the interview), asking open-ended questions, and evaluating the witness's state of mind.

- Do not rush witnesses while they are describing the accident; do not be judgmental, hostile, or argumentative; do not display anger, suggest answers, threaten, intimidate, or blame the witness; do not make promises of confidentiality, use inflammatory words, ask questions that suggest an answer, or omit questions because you think you know the answer.

KEY POINTS TO REMEMBER (Continued)

- Mapping and photographing the accident scene are important, because precise visual representations of the accident scene and pinpointing the location of evidence before it is moved are necessary to ensure that the board has the means to develop and test causal theories.

- Remove evidence carefully, tagging and packaging it to preserve its integrity.

- Before removing evidence from the accident scene, follow these guidelines:
  - If possible, removal should not begin until witnesses have been interviewed
  - Extraction and removal or movement should not be started until the scene and the location of evidence has been documented
  - Exercise caution and be alert for unsafe conditions or weakened structures
  - The location of removed material can be marked with paint or flags
  - Avoid defacing or distorting impact marks and fracture surfaces
  - The board should concur on removal

- Follow precautions when handling potential bloodborne pathogens.
  - Documentary evidence is generally grouped into four categories:
  - Management control documents
  - Records that indicate past and present status of work activities
  - Reports of studies, analyses, audits, etc.
  - Follow-on documentation that describes actions taken in response to other types of documentation.

- Consider the role of management systems when collecting and reviewing evidence, and gather all evidence that could reveal deficiencies in safety management.

- Use the guiding principles and core functions of the integrated safety management system to form questions that will guide evidence collection and analysis of all levels of management systems, from the first line supervisor up to and including Headquarters.

- Establish a chain of custody for evidence and ensure that it is strictly maintained throughout the investigation.

Accident Investigation Preliminary Interview List

Date/time of interview	Location of interview	Board member(s) interviewing	Individual to be interviewed	Title/position of interviewee	Notes

Accident Investigation Interview Form

Interviewee: **Title/Position:**	**Interviewer:** **Title/Position:**	**Page __ of __**
Others present:		**Date:** **Time:**
Initial Questions:		
Follow-Up Questions:		
Observations of Interviewee:		
Notes:		

MODEL OPENING STATEMENT

[To be recorded]

Let the record reflect that this interview has commenced at (time, date. and place).
I'm (state interviewer's name(s) and employment affiliation(s). i.e., I'm Joe Smith of the Idaho Operations Office of the Department of Energy. With me are (name and organization of other Department personnel). For the record, please state your full name, company affiliation, job title, or position.

Read into record the names and employment of any additional persons present (other than the recorder).

The Department has established an accident investigation board to determine the facts that led to the (accident date) accident at (place of accident). The principal purpose of this investigation is to determine the facts surrounding the accident so that proper remedial measures can be instituted to prevent the recurrence of accidents. We have authority to conduct this investigation under the Department of Energy Organization Act, which incorporates provisions of the Atomic Energy Act of 1954 authorizing investigations of this type.

Your appearance here to provide information is entirely voluntary, and you may stop testifying and leave at any time. However, you should understand that giving false testimony in this investigation would be a felony under 18 U.S. Code Section 1001. Do you understand that?

You have the right to be accompanied by an attorney or a union representative. (If witness has attorney or a union representative, put the name of such person into the record.) "Let the record reflect that Mr./Mrs./Ms. is accompanied by" (as his/her attorney or union representative).

We would like to record this interview to ensure an accurate record of your statements. A transcript of this discussion will be produced, and you will have an opportunity to review the transcript for factual accuracy and corrections. If you do not wish to have the session recorded. we will not do so. Do you have any objection to having the session recorded?

We will attempt to keep your testimony confidential but we cannot guarantee it. At a later date, we may have to release your testimony pursuant to a request made under the Freedom of Information Act, a court order, or in the course of litigation concerning the accident, should such litigation arise. Do you want your testimony to be considered confidential? (wait for answer--if answer to preceding question is affirmative).

Accident Investigation Physical Evidence Log Form

					Acknowledgements of Transfer	
Tag Number	**Evidence Description**	**Original Location Reference**	**Storage Location**	**Inventoried & Tagged by: Name/Signature/ Date/Time**	**Released by: Name/Signature/ Date/Time**	**Received by: Name/Signature/ Date/Time**

Attach copy of *Accident Investigation Sketch of Physical Evidence Locations*

Accident Investigation Site Sketch

Board Member:	**Date:**
Title:	**Time:**

Sketch Orientation

Attach copy of *Accident Investigation Position Mapping Form*

Accident Investigation Site Map

Board Member:	**Date:**
Title:	**Time:**

Sketch Orientation

Attach copy of *Accident Investigation Position Mapping Form*

Accident Investigation Position Mapping Form

Board Member: Title:		Date: Time:		
Code #	**Object**	**Reference Point**	**Distance**	**Direction**

Attach copy of *Accident Investigation Site Map* and *Accident Investigation Site Sketch*

Accident Investigation
Sketch of Physical Evidence Locations and Orientations

Board Member:	**Date:**
Title:	**Time:**

Sketch Orientation

Attach copy of *Accident Investigation Physical Evidence Log Form*

Accident Investigation Photographic Log Sheet

Photographer:	**Location:**
Camera Type:	**Date:**
Lighting Type:	**Time:**
Film Roll No:	

Photo No.	Scene/Subject	Date of Photo	Time of Photo	Lens f/ℓ	Direction of Camera	Distance from Subject

Accident Investigation
Sketch of Photography Locations and Orientations

Board Member:	**Date:**
Title:	**Time:**

Sketch Orientation

Attach copy of *Accident Investigation Position Mapping Form*